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Al-Ir-Ru (Aluminum-Iridium-Ruthenium)

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A tentative liquidus projection and the phase distribution on solidification were reported for this ternary system by [1999Hil], except in the region close to the Al corner.

Binary Systems

Recently, the Al-rich part and the Ir-rich part of the Al-Ir phase diagram were investigated by [2008Pav] and [2008Zha] respectively. The intermediate phases in this system are: Al_9Ir_2 ($D8_d$, Co_2Al_9-type monoclinic), $Al_{45}Ir_{13}$ (orthorhombic, space group *Pnma*), $Al_{28}Ir_9$ (tetragonal, *P*31*c*), Al_3Ir ($D0_{18}$, Na_3As-type hexagonal), $Al_{2.7}Ir$ (cubic, *P*23), and AlIr (*B*2, CsCl-type cubic). The Al-Ru phase diagram [2003Mi] has six intermediate phases: Al_6Ru (orthorhombic, *Cmcm*), $Al_{13}Ru_4$(monoclinic, *C*2/*m*), Al_5Ru_2 (orthorhombic, *Cmcm*), Al_2Ru ($C54$, $TiSi_2$-type orthorhombic), Al_3Ru_2 (Os_2Al_3-type tetragonal), and AlRu (*B*2, CsCl-type cubic). The Ir-Ru phase diagram [Massalski2] is a simple peritectic system, with the maximum solubility of 45 at.% Ru in Ir and 49 at.% Ir in Ru at the peritectic temperature of 2395 °C.

Ternary Phase Equilibria

With starting metals of 99.99% Al, 99.98% Ir and 99.98% Ru, [1999Hil] arc-melted about 15 ternary alloys under Ar atm. The samples were examined only in the as-cast condition in the scanning electron microscope. The phase composition was determined with energy dispersive x-ray spectroscopy. Structural analysis was done with x-ray powder diffraction. The phase distribution obtained on solidification is shown in Fig. 1 [1999Hil]. The isomorphous compounds AlIr and AlRu solidifiy as a continuous solid solution labeled *B*2 in Fig. 1. The Al range of this solid solution reaches a minimum, about midway between the end members. (Ir) and (Ru) show extensive mutual solid solubility as well as significant Al solubility. A ternary compound of unknown structure labeled Q (Fig. 1) forms at the composition $Al_{53}Ir_{20}Ru_{27}$. Al_3Ru_2 (which forms in the solid-state) and the high-temperature phase Al_5Ru_2 do not appear in Fig. 1. The binary compounds $Al_{2.7}Ir$ and Al_3Ir dissolves about 10 and 11.3 at.% Ru respectively. $Al_{13}Ru_4$ and Al_2Ru dissolve up to 12 and 4.6 at.% Ir respectively. The phase equilibria near the Al corner were not investigated by [1991Hil].

The liquidus projection deduced by [1991Hil] from microstructural observations is shown in Fig. 2. This projection should be considered tentative, as no thermal analysis was performed by [1999Hil]. The phases of primary crystallization are marked. The continuous *B*2 field divides the composition triangle into two parts. The transition reaction U_1: L + (Ir) ↔ *B*2 + (Ru) occurs on the Al-lean side. On the Al-rich side, the ternary phase $Al_{53}Ir_{20}Ru_{27}$(Q) forms through the ternary peritectic reaction P: L + Al_2Ru + *B*2 ↔ Q. There are a number transition reactions occurring at Al-rich compositions. The solidification sequence close to the Al corner is not known.

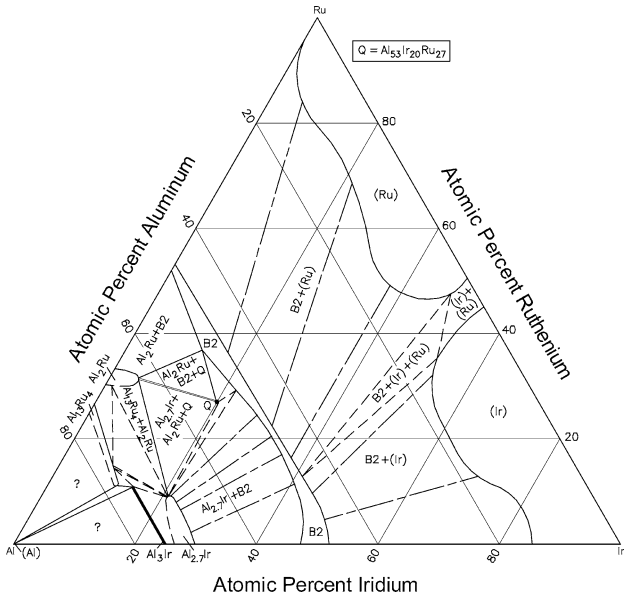

Fig. 1 Al-Ir-Ru phase distribution on solidification [1999Hil]

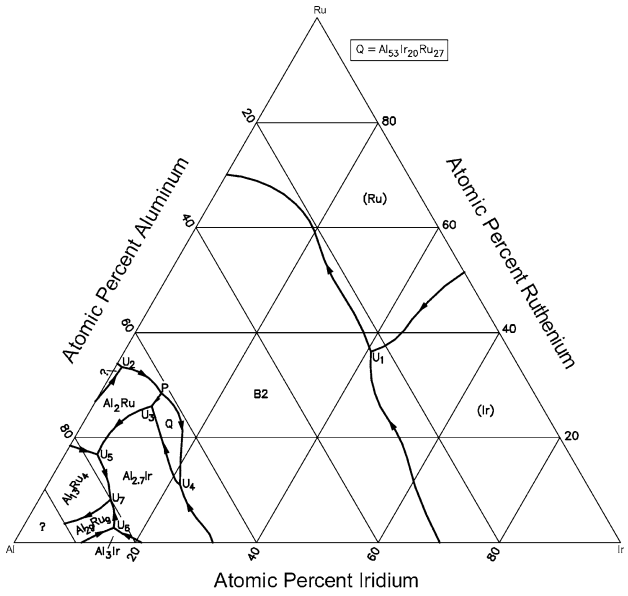

Fig. 2 Al-Ir-Ru tentative liquidus projection [1999Hil]

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